
OutBack
POWER™

SkyBox – Simplifying Solar + Storage

Introduction and Installation

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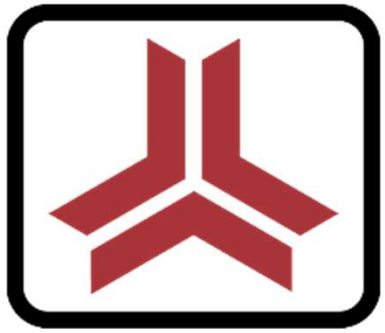
OutBack Power Technologies



SKYBOX

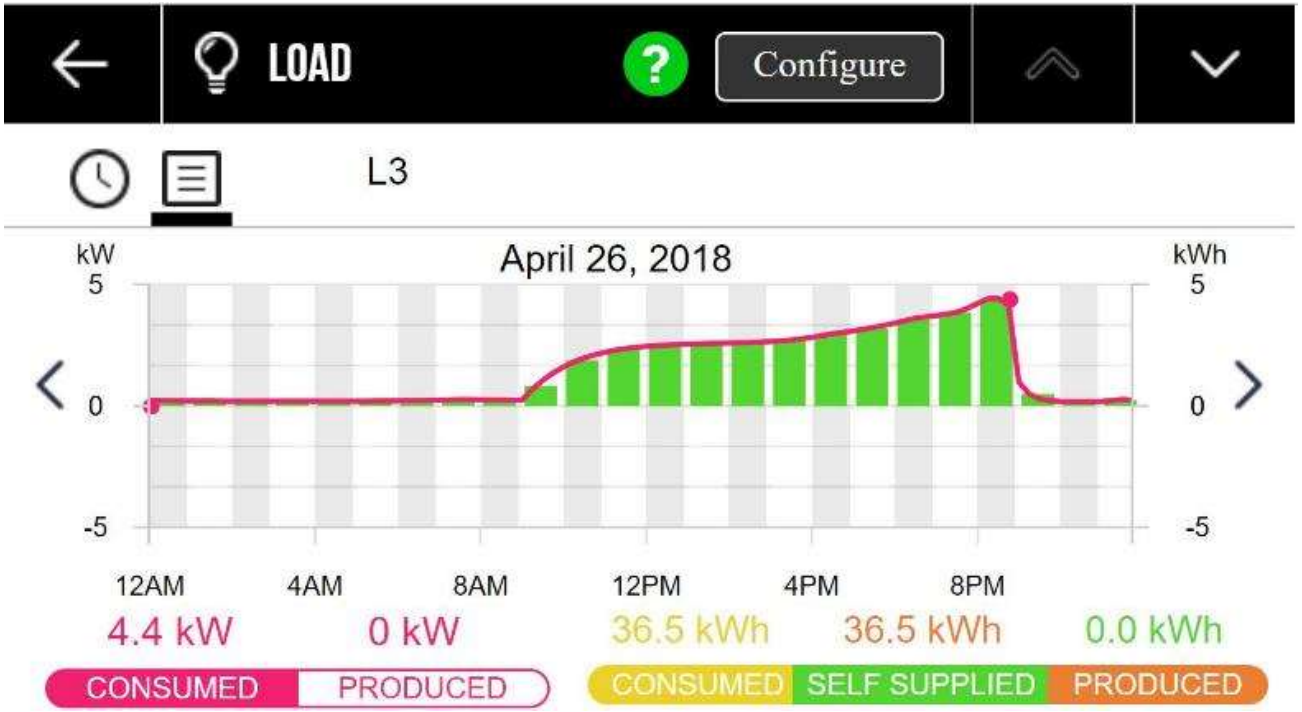
TRUE HYBRID ENERGY SYSTEM

OutBack POWER™
member of The alpha Group™

Introduction to SkyBox

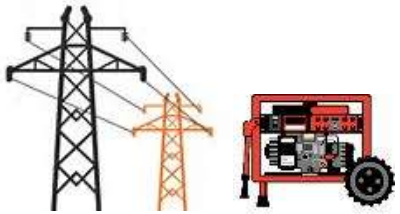
- SkyBox Introduction
- Battery Options

SkyBox Applications and Introduction



SkyBox True Hybrid Energy Management

5kW in any direction 120/240V 60Hz



Resilient
- Immediate backup power
- Supports generator
- Durable product
- Fewer service calls
- Remote support

Adaptable
- NEMA 3R
- Drop-in replacement
- Works with widest variety of 48V battery chemistries
- Stackable (enabled via software)

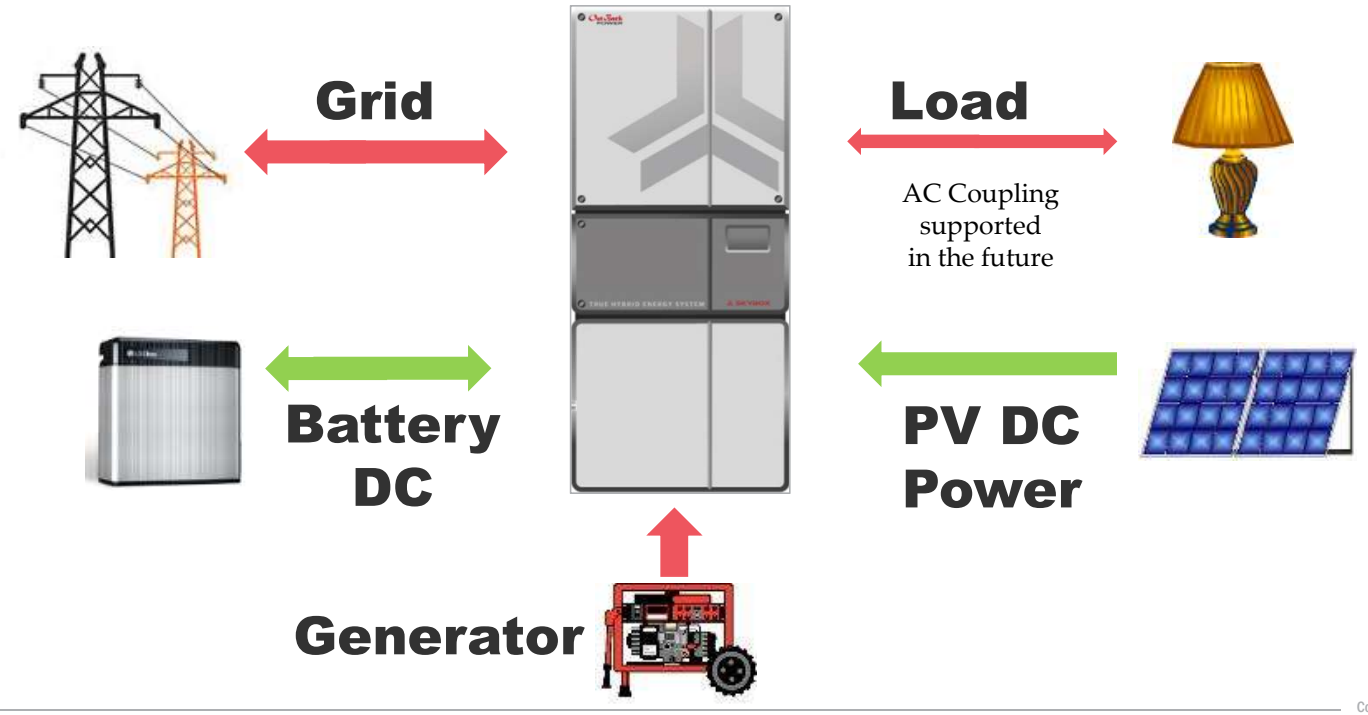
Simple
- Easy and fast to install
- Clean BOS, all-in-one box
- High PV voltage input allows long strings

Intelligent
- Dynamic power management
- Ability to support new regulatory needs

SkyBox 5-Port Design

Controllable at Each Connection Point

The Grid, Load, and Battery are bidirectional allowing for ***adjustable*** export or import at each location



Core Values

Enabling YOU to Take Charge of YOUR Energy

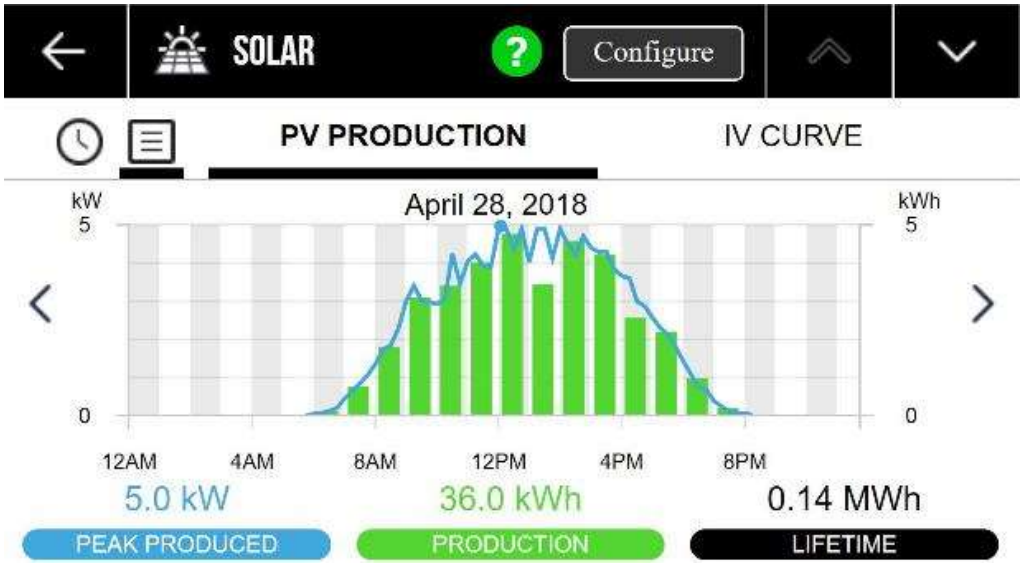
Designed simple, smart, cost effective Renewable Energy (RE) system optimized for mainstream, grid-tied worldwide market

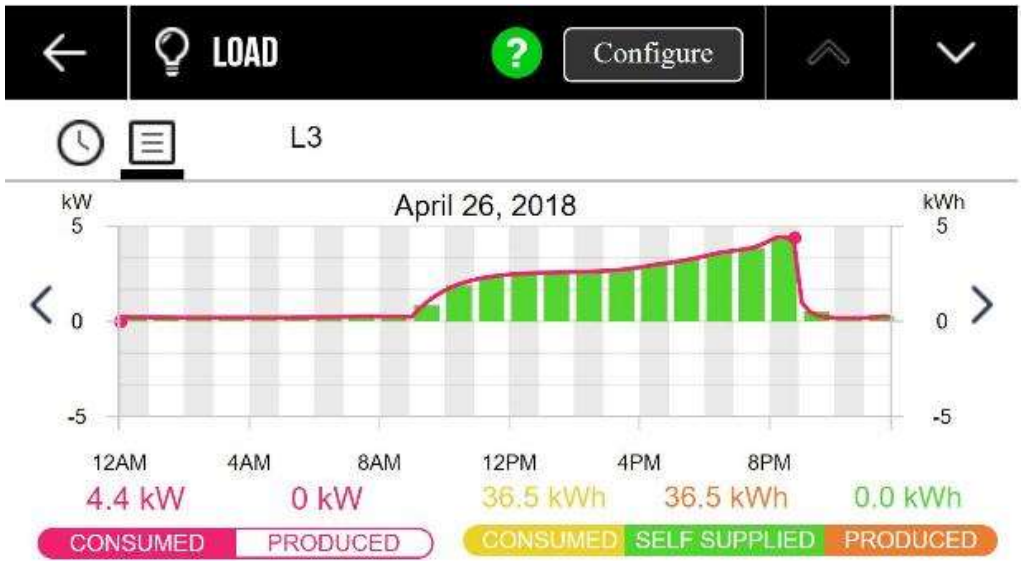
- Residential energy storage system for back-up power and self-consumption on or off the grid
- Can be used with or without energy storage
- Comparable in ease of installation, operation, efficiency and reliability to simple grid-tied inverters
- Smart inverter able to measure and control power from multiple connection points: utility, loads, PV and storage
- Choose energy storage that's right for the customer and application

Resilient **Adaptable** **Simple** **Intelligent**

Why Solar + Storage

The market drivers for storage





- Financially-Driven Use Cases
  - Easiest storage solution to install
  - PV self consumption
  - Time-of-use rate arbitrage
- Functionally-Driven Use Cases
  - Backup/resiliency
  - Future-proof PV system
- Emotionally-Driven Use Cases

Automate Your Savings

- SkyBox makes it easy for you!
  - You just enter the data and SkyBox maximizes your ROI
  - The more data you input, the more accurate SkyBox can be
- SkyBox determines lowest-cost energy source and chooses it
  - If battery cost is less than Super Off-Peak rate, SkyBox will seek to serve loads from battery
- Can set battery reserve level for backup power

- Potential Inputs
  - Rate Schedule
  - Allowable Export
  - Battery replacement costs
  - Reserve battery percentage

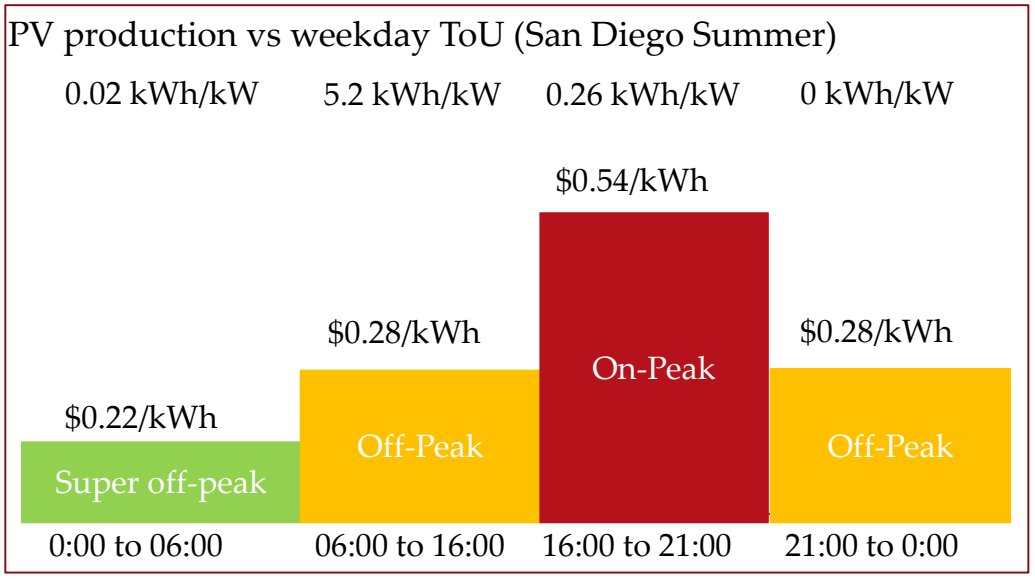
Levelized Cost of Energy

Energy Storage

- Cost of cycling battery
  - Initial installed cost of Battery
  - Charge/discharge losses
  - Parasitic losses (BMS, HVAC, etc.)
- Peak vs. off-peak rates
  - Is difference enough to pay for battery cycle cost?

$$\frac{\text{Installed Cost}}{(\text{Useable Capacity} \times \text{Cycle Efficiency})(\text{Cycle Life})} = \text{LCoE}_{\text{Batt}}$$

$$\text{Peak rate} - \text{Off Peak rate} \geq LCOE_{Batt}$$



Specifications

Backup power with Energy Storage OR Energy Storage Optional

- **Continuous Power Rating:** 5kW in any direction
- **Maximum AC Current to Loads and Grid:** 24 Aac (120V or 240V)
- **AC Input / Output Voltage:** 120/240Vac
- **Maximum AC Input Power:** Up to 240V @ 60A AC pass-through from grid
- **MPPT Voltage Window from PV:** 250 to 600 Vdc
- **Battery Voltage Window:** 42-60 Vdc
- **Operating Temperature Range**: -20°C to 60°C
- **CEC Weighted Efficiency PV to Grid:** 94%
- **Total Harmonic Distortion:** Typical <2%
- **Field Upgradable Firmware:** Yes
- **Non-volatile Memory:** Yes
- **Environmental:** NEMA3R

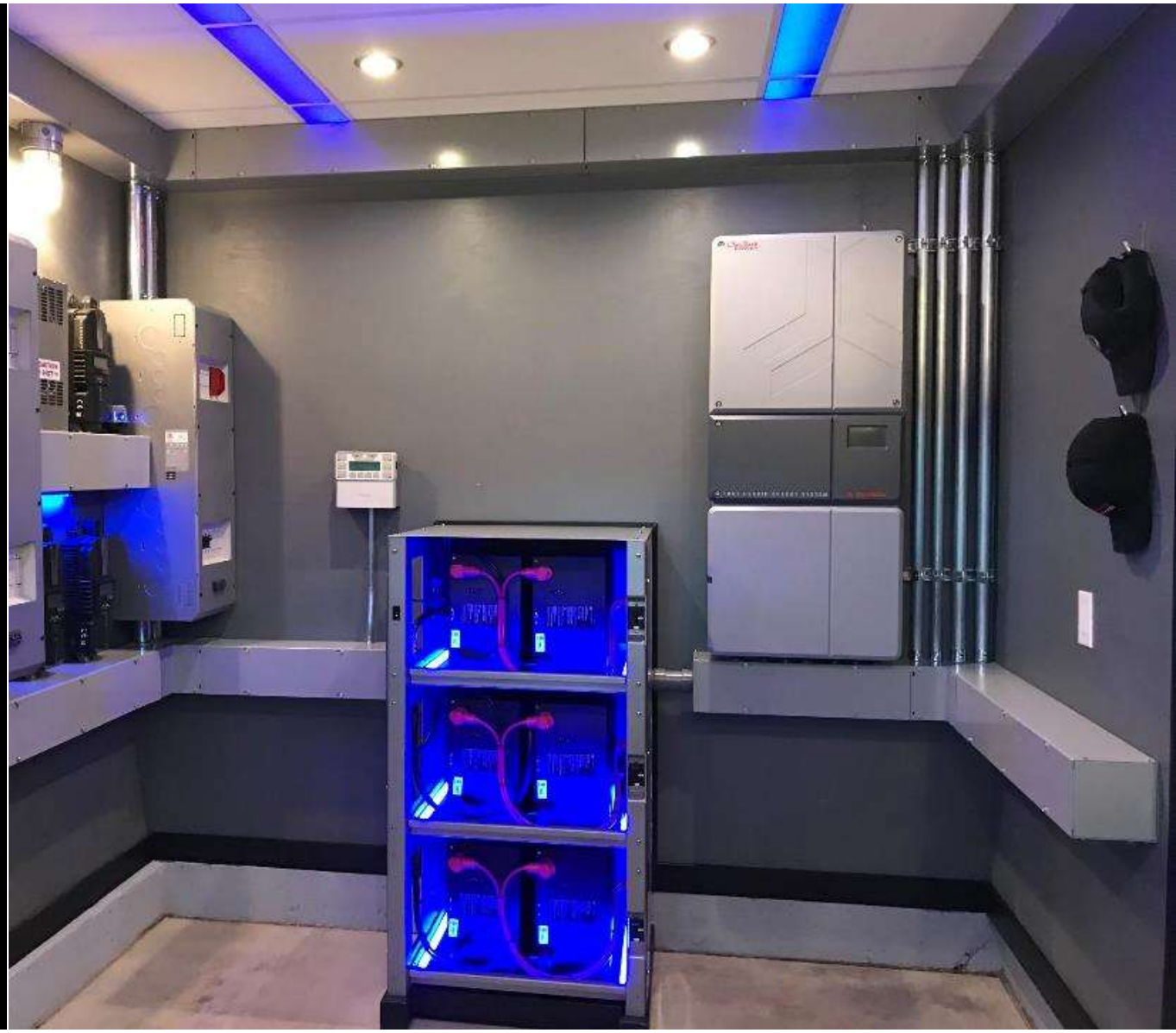
Value Proposition
Positioning

- Financially-Driven Use Cases
  - Easiest storage solution to install
  - PV self consumption
  - Time-of-use rate arbitrage
- Functionally-Driven Use Cases
  - Backup/resiliency
  - Future-proof PV system
- Emotionally-Driven Use Cases
  - Hedge against utility rate changes
  - Urban off-grid

- True Multi-Mode Inverter
  - Can install without batteries and add them later
- Immediate Backup
  - No down-time, digital clocks don't reset, etc.
- Full 5 kW in any operating mode
- Off-Grid Capable
  - Generator-friendly
  - Grid-forming
- Compatible with Low-Cost Batteries
  - Can use 48-VDC VRLA or Li-ion batteries

SkyBox features support primary value drivers

Battery Options



SkyBox Batteries

Low cost lead acid

OR

Advanced chemistries

The Best Battery…

SkyBox + SimpliPhi

Off-Grid/Unreliable Grid

SkyBox + LG

ToU

SkyBox + NC

Self Consumption

SkyBox + PLR

Backup

…might not be the same for each application

Summary

Take Charge of Your Energy!

- PV and battery backup delivered seamlessly from an all-in-one solution
- Comply with grid interconnection limitations
- TOU: use your PV and your battery when electricity is expensive
- DC coupled for highest efficiency
- Remote monitoring and updates via OpticsRE
- Compatible with widest range of batteries LG Chem RESU10 48V and all OutBack lead acid batteries

Installation of SkyBox

- Mechanical
- Software

SkyBox Mechanical Installation

Skybox Hardware Components

Included with SkyBox True Hybrid Energy System

- **Integrated inverter**
  - With inputs for PV, batteries, grid, and generator
  - And output for back up loads
  - Comes with interactive display screen
  - Can connect to a local network and view/modify from any tablet or PC
  - If the router allows access to port 3000, this can be done over the internet
- **Easy to wire BOS box**
- **Remote Temperature Sensor**

Quick Start Guide

OutBack POWER

Specifications

Listings:

- UL1741
- IEEE1547

Certifications:

- UL1778 (T)
- NEC® (V1)
- California Rule 21 SRD
- IEEE 1547

System Grounding and Bonding:

In this product, the PV, AC, and battery circuits are isolated from the enclosure. This product has been evaluated, listed and identified by UL to meet the requirements of 690.41 and 250.4(A) of the NEC.

- The PV system ground reference and protection is provided internal to the SkyBox, in accordance with NFPA 70 690.41(A)(4).
- The AC connections are not bonded to ground. The usual location for a neutral-ground bond is at the main AC service panel. Make sure to establish a neutral-ground bond when installing in an off-grid application.
- The battery connection is not bonded to ground. Make sure to establish a negative-ground bond for each battery system.

Equipment grounding is required by Section 250 of the

Quick Start Guide

OutBack POWER

SKYBOX True Hybrid Energy System

Electrical Specifications

- Maximum continuous output: 6000 VA @ 25°C
- Nominal input and output voltage: 120/240 Vac
- Nominal frequency: 60 Hz
- Maximum continuous output current: 24 Aac
- Maximum grid input current: 48 Aac
- Maximum utility breaker size: 60 A
- Maximum output fault current:
- Maximum generator input current:
- Maximum PV source voltage: 600 Vdc
- Operating PV source voltage range: 200 to 600 Vdc
- Maximum PV input current: 20 Adc
- Maximum PV short-circuit current: 32 Adc
- Aux output: 0.6 A @ 12 Vdc
- Aux relay: 10 A @ 240 Vac, 5 A @ 30 Vdc
- Nominal battery voltage: 48 Vdc
- Maximum battery input current: 140 Adc
- Battery input voltage range: 42 to 60 Vdc
- Charging output voltage range: 42 to 60 Vdc
- Supported battery chemistries:

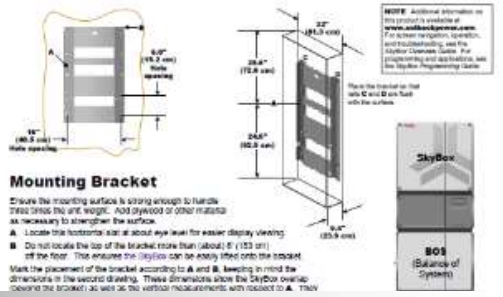
Mounting Bracket

Ensure the mounting surface is strong enough to handle three times the unit weight. Add plywood or other material as necessary to strengthen the surface.

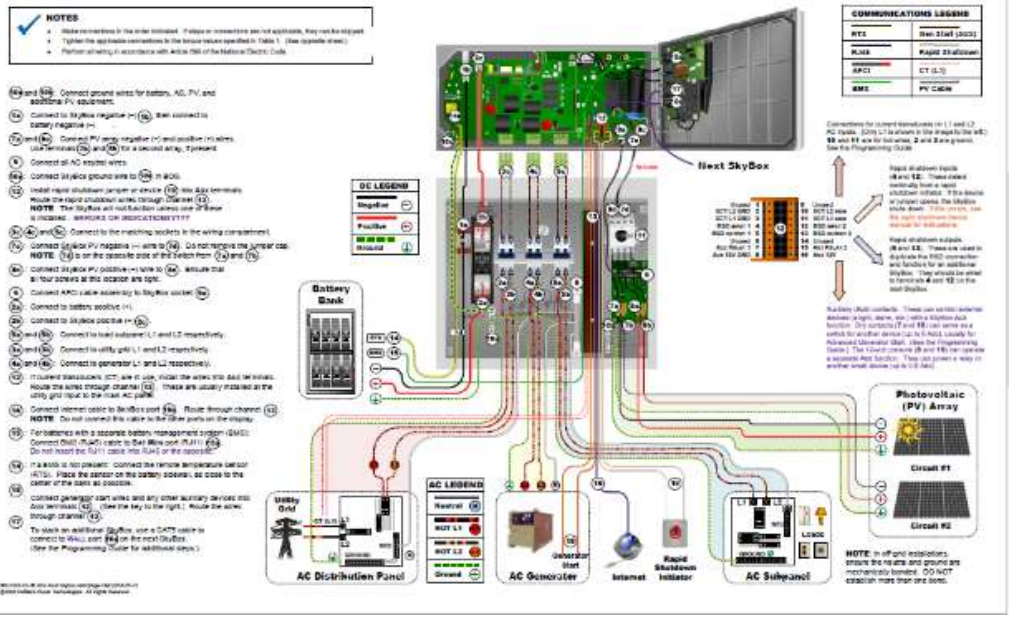
A Locate this horizontal slot at about eye level for easier display viewing.

B Do not locate the top of the bracket more than (about) 6' (183 cm) off the floor. This ensures the SkyBox can be easily lifted onto the bracket.

Mark the placement of the bracket according to **A** and **B**, keeping in mind the dimensions in the second drawing. These dimensions allow the SkyBox overlap (beyond the bracket) as well as the vertical measurements with respect to **A**. Then

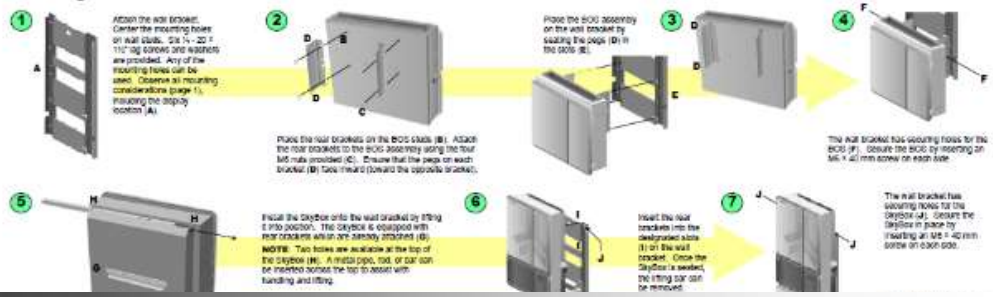


Wiring



Mounting

Mounting



Commissioning

Prestartup Procedures:

1. Double check all wiring connections. Confirm that a neutral-ground bond is present in the system.
2. Inspect the enclosure. Assure no debris or loose wire nuts inside.
3. Ensure all AC loads at the backup (or protected) load panel are disconnected.
4. Ensure all AC input feeds to the BOS are disconnected at each source.
5. Using a Phillips screwdriver, remove the clear plastic (dead front) panel (not depicted). The four required screws are marked with ■ in the image to the right.
6. Energize the system as below. Follow the procedures which are applicable to the system. If any elements are not present (including batteries, PV, or a generator), ignore those procedures.

To energize the SkyBox:

1. If batteries are present, verify input of Vdc using a digital voltmeter (DVM) by measuring from (5a) to (5b).

   If batteries are not used in this system, skip to step 2.

   Confirm the correct battery voltage and polarity. If the red LED indicator (5a) is lit, the polarity is reversed. DO NOT turn on the circuit breaker.

2. Once proper voltage and polarity are confirmed, turn on (close) the main battery circuit breaker (3).

CAUTION: Equipment Damage

Incorrect battery polarity will damage the equipment.

3. On the first power up, a welcome message is shown. The right arrow ▶ proceeds to the setup wizard. This steps through language, region, and similar changes, then PV, battery, and AC settings. On the last screen, the HOME key proceeds to the Home screen.

   After the first power up, the Home screen appears after every power reset.

4. From the Home screen, turn on the SkyBox with the On/Off key (J).
5. Using a DVM, test the inverted output voltage at (5c) and (5d). Do not close the Loads circuit breaker (4).
6. IF GRID IS PRESENT: Turn on the utility grid connection to the BOS at the source.
7. Verify 120 Vac on Grid L1 by measuring with a DVM from (5a) to (5). Verify L2 by measuring from (5b) to (5).
8. Verify 240 Vac across the Grid-line-lines by measuring from (5a) to (5b).
9. Turn on (close) the Grid circuit breaker (2). The inverter will appear for the first time if no batteries are installed. Perform steps 9 to 11 and 4 if this is the case.
10. Using a DVM, test the pass-through (transfer) L1 output voltage at (5c) and (5). Test the L2 voltage at (5d) and (5). Do not close the Loads circuit breaker (4).
11. Turn off (open) the Grid circuit breaker (2).

12. If PV is present, verify that the input is in the correct range of open-circuit voltage. Confirm polarity by measuring with a DVM from (5a) to (5c) and from (5a) to (5d) (as appropriate).
13. Check the green LED indicators (5a) and (5b). If a single PV input is installed, one indicator should light. If two strings are installed, both should light. Any other behavior means the polarity must be reversed. Do NOT turn on the system.

CAUTION: Equipment Damage

Incorrect PV polarity will damage the equipment.

14. Turn on (close) the PV system (1). Check indicators (5a) and (5b) again. If a single PV input is present, the second indicator should light. If two strings are present, both should remain on. Any other behavior means the polarity at the top of the PV system may be reversed.
15. Turn on (close) the Loads circuit breaker (3). Do not connect loads at the protected load panel.
16. Verify 120 Vac on Load L1 by measuring with a DVM from (5a) to (5). Verify L2 by measuring from (5b) to (5).
17. Verify 240 Vac across the Loads terminals by measuring from (5a) to (5b).
18. Connect and test loads at the protected load panel.
19. If a generator is present, start the generator. Do not turn on (close) the Gen circuit breaker (4). Repeat steps 7 and 8 using (5a), (5), and (5).
20. Turn on (close) the Gen circuit breaker (4). Repeat step 10. The Loads circuit breaker may remain on (closed).
21. Stop the generator.
22. Turn on (close) the Grid circuit breaker (2). Wait for the programmed connection delay to elapse. Test any grid-interactive functions.

To de-energize or shut down the system:

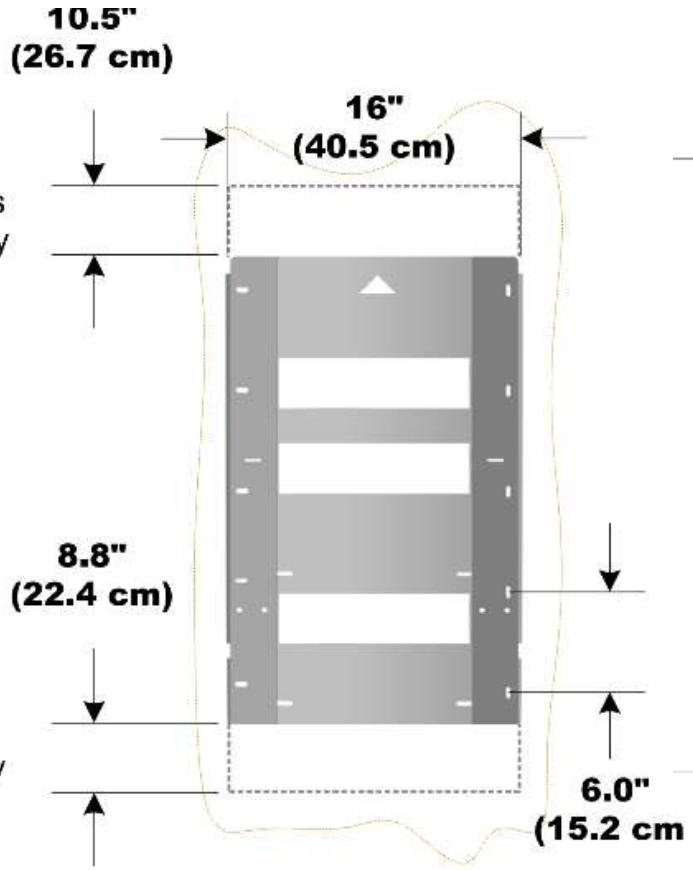
There is no required shutdown order. It is common to de-energize circuits in the reverse order from which they were energized.

WARNING: to ensure safety, ALL sources (battery, PV, and AC) must be completely de-energized before performing maintenance. After all energy sources are disconnected, allow unit to rest for at least 5 minutes before performing any maintenance. (EXIT)

Mounting bracket

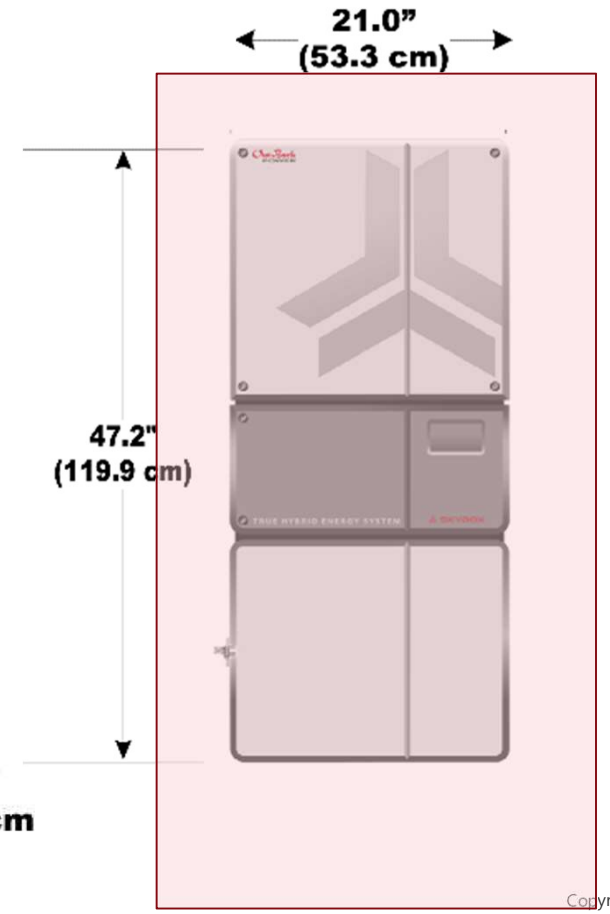
Installation Procedure

Clearance:
6″ top and sides
36″ clearance below



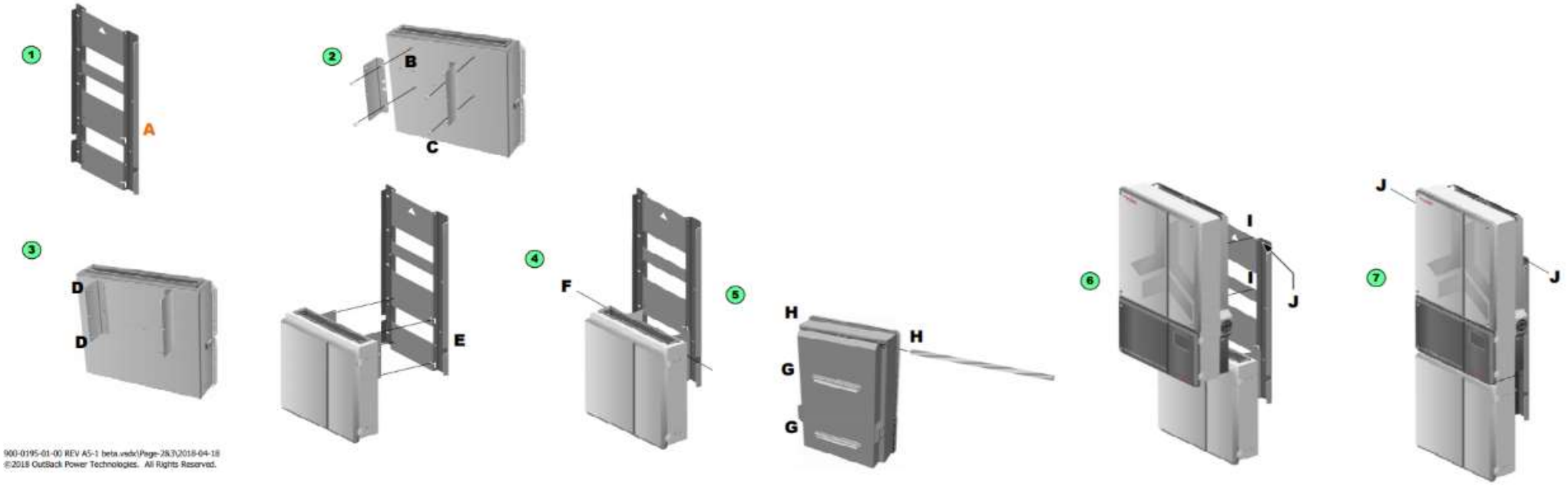
NOTE:
The SkyBox extends above the bracket by this amount.

NOTE:
The BOS extends below the bracket by this amount.



Balance of System

Installation procedure



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Weights and Tools Needed

Weights

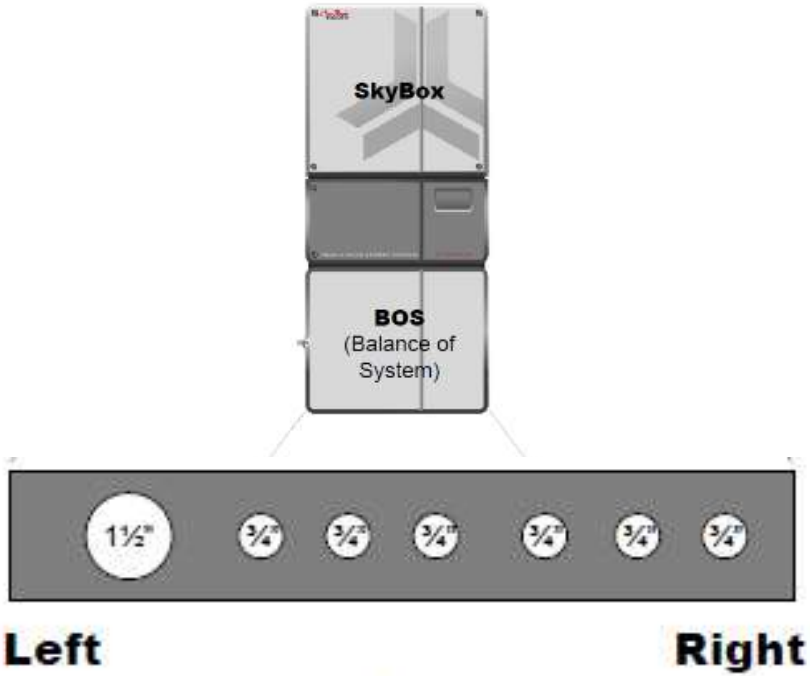
- Skybox: 87.7 lb (39.8 kg)
- BOS: 23.6 lb (10.7 kg)
- Mounting Bracket: 4.6 lb (2.1 kg)

Tools Needed for working inside SkyBox

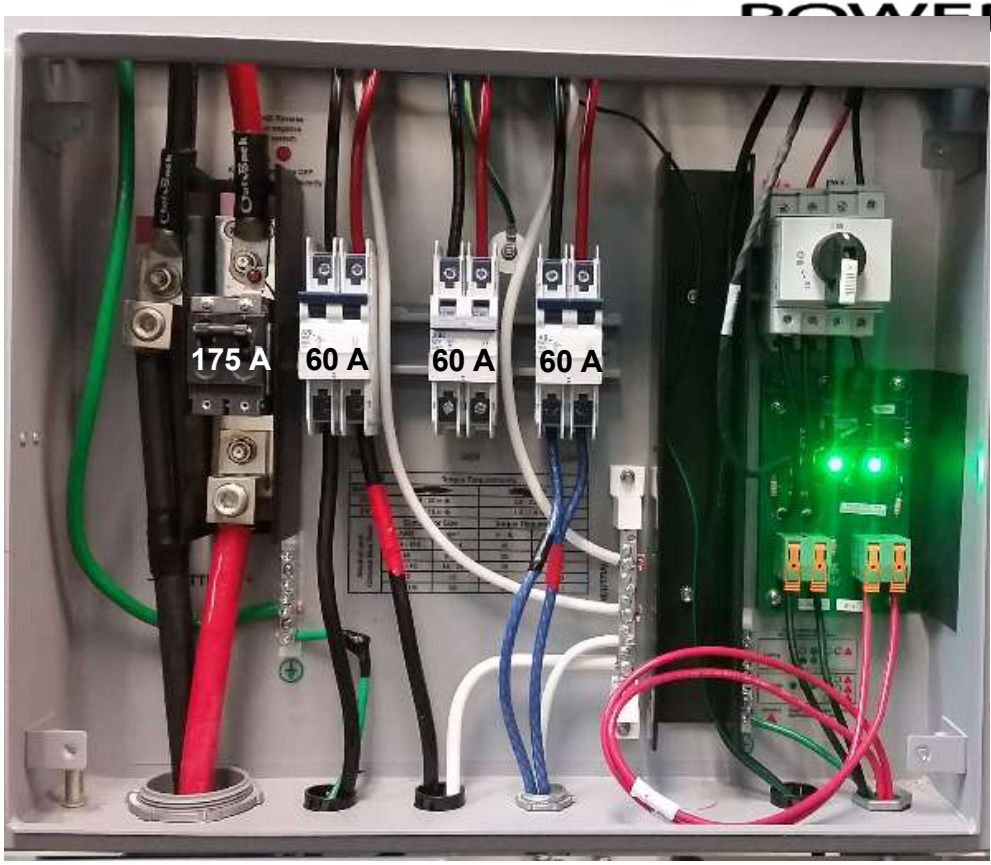
- 13 mm socket (torque) wrench
- #2 Phillips (torque) driver
- Flat blade (torque) driver
- 6 mm Allen wrench
- Digital multimeter (DMM)

Conduit and Conductors

Simple Layout



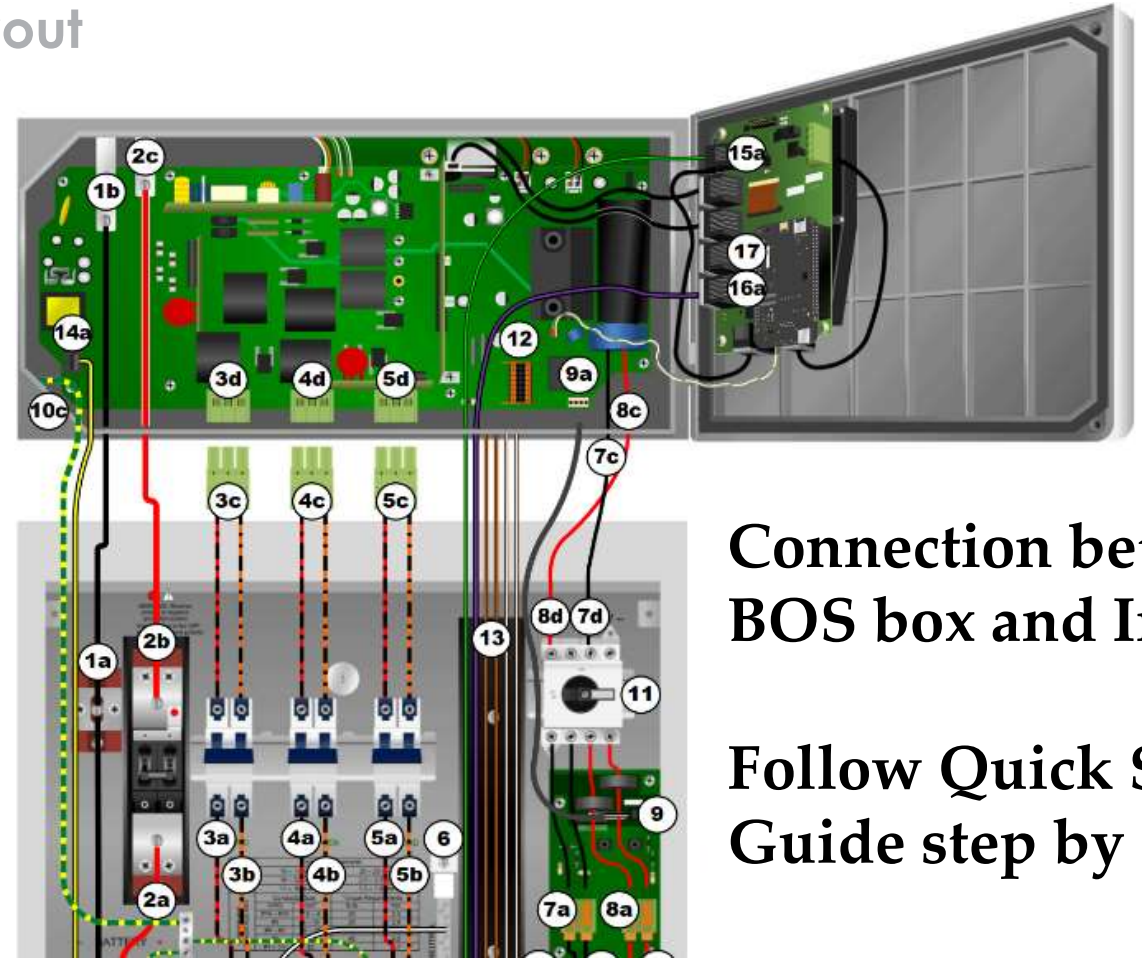
Conduit Knockouts (Underside of BOS)



Battery Grid Gen Backup Loads Comms PV

Connection BOS to Inverter

Simple Layout



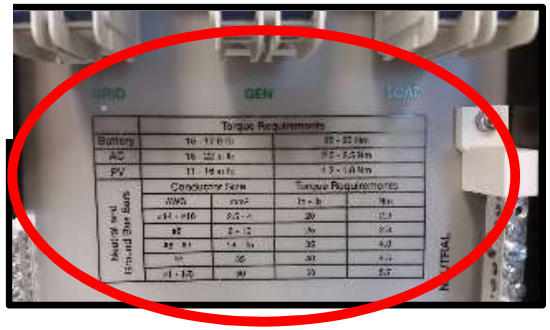
Connection between BOS box and Inverter.

Follow Quick Start Guide step by step

Torque Specifications

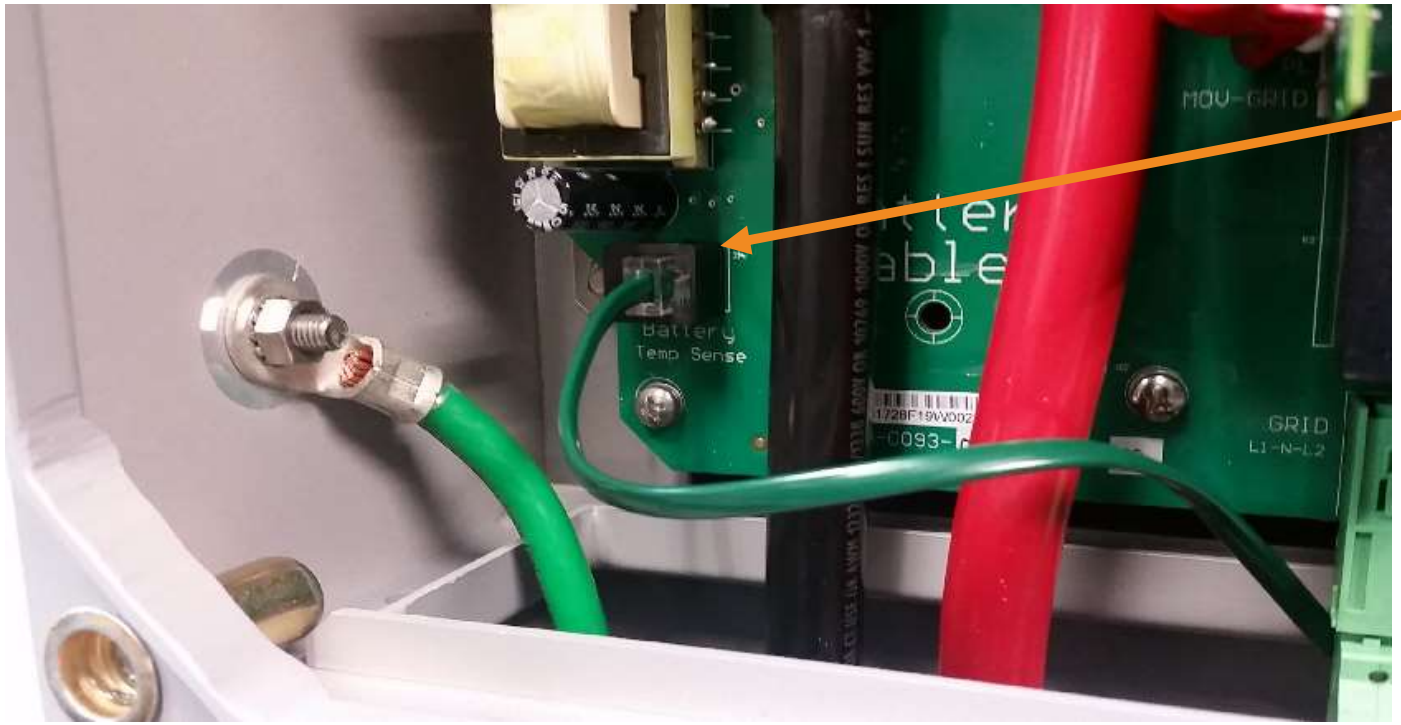
Printed In the Wiring Box

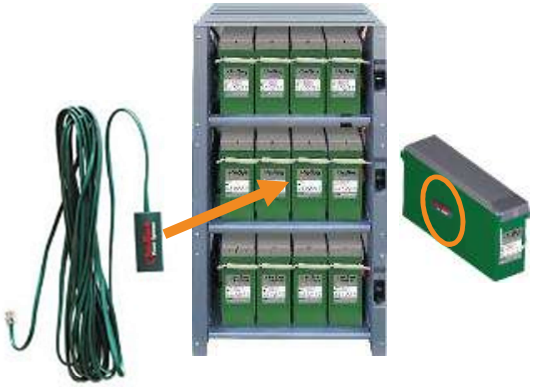
Table 1: Wires and Conductors				
	Permitted Sizes		Torque Requirements	
	AWG	mm^2	In-lb	Nm
Battery	2/0 to 4/0	70 to 120	65 to 75 in-lb	7.3 to 8.5 Nm
AC	#8 to #3	6 to 25	18 to 22 in-lb	2.0 to 2.5 Nm
PV	#18 to #4	1.5 to 25	11 to 16 in-lb	1.2 to 1.8 Nm
Aux	#24 to #16	0.25 to 1.5	N/A	N/A
Neutral, Ground, and PV Ground	#14 to #10	2.5 to 4	20	2.3
	#8	6 to 10	25	2.8
	#6 to #3	16 to 25	35	4.0
	#2	35	40	4.5
	#1 to 1/0	50	50	5.7



Battery Temp Sensor

Same sensor as used with other OutBack products

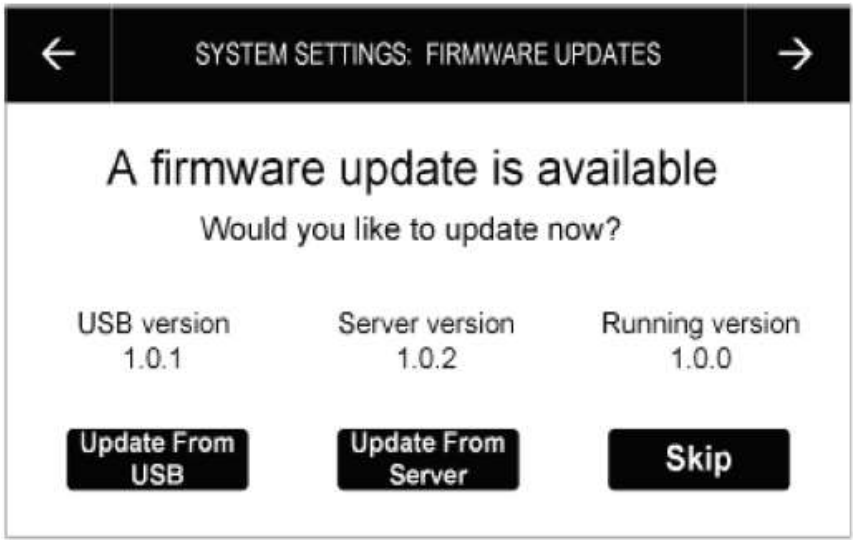




SkyBox Software Installation

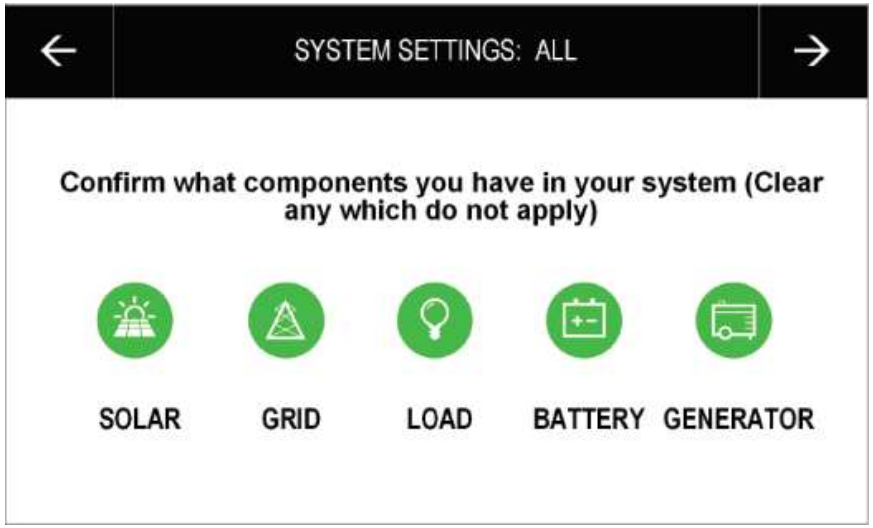
Setup Wizard

1. SYSTEM LANGUGE
2. WIZARD INSTALLATION
3. SYSTEM SETTING: DISPLAY
4. SYSTEM SETTINGS: INTERNET CONNECTION
5. SYSTEM SETTINGS: FIRMWARE UPDATES
6. SYSTEM SETTINGS: REGIONAL SETUP

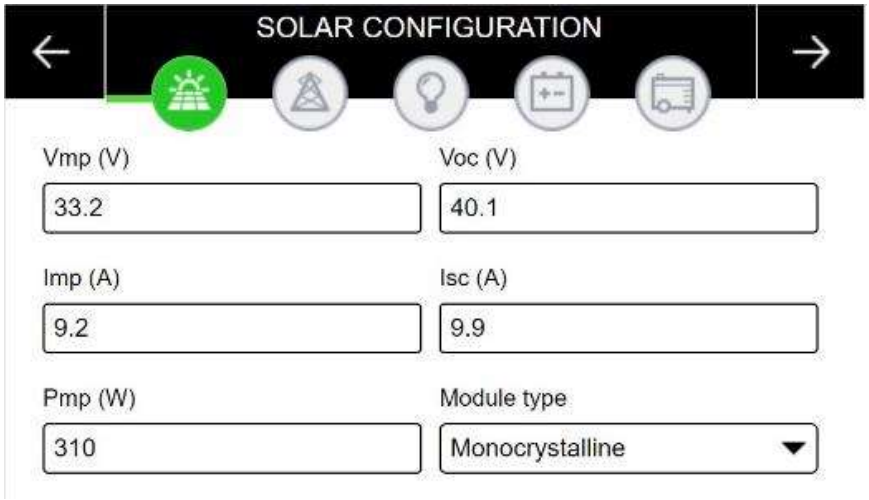


Setup Wizard

7. SYTEM COMPONENTS: ALL

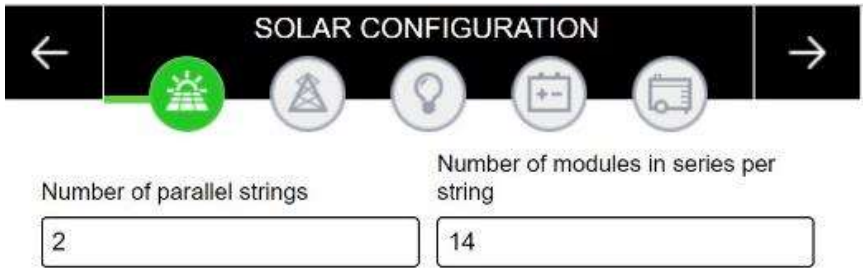


8. SOLAR CONFIGURATION

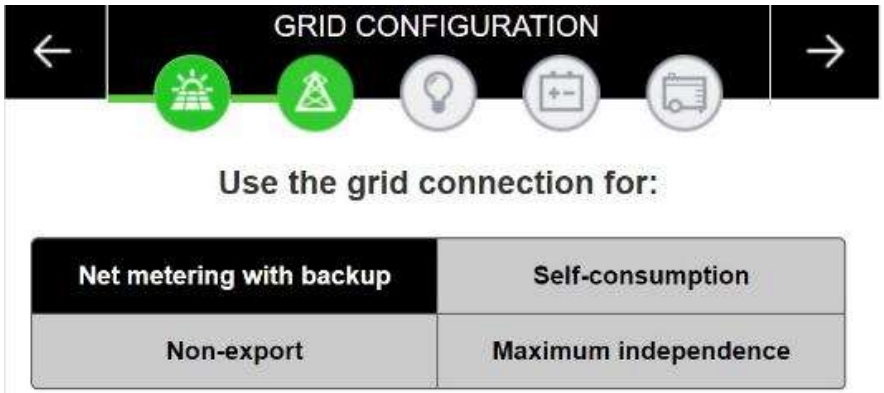


Setup Wizard

7. SOLAR CONFIGURATION

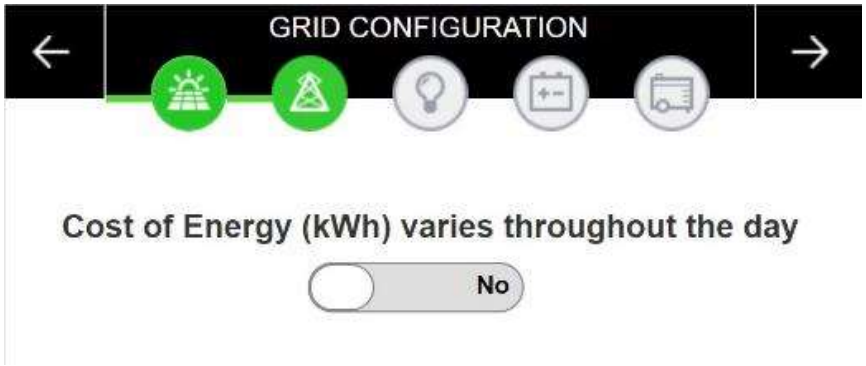


8. GRID CONFIGURATION

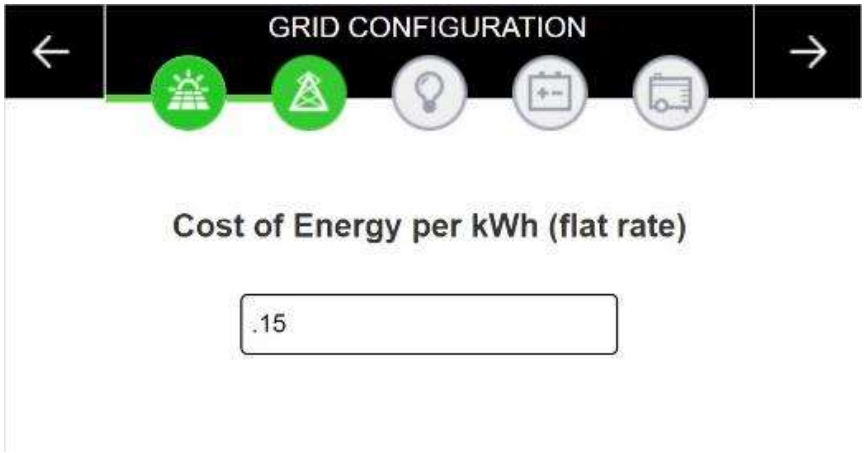


Setup Wizard

9. COST OF ENERGY



10. COST OF ENERGY



Skybox System Profiles

SELECTABLE FOR SPECIFIC APPLICATIONS

Non-Export

- Export to the grid is prohibited; thus small power drawn from the grid is maintained at all times.
- When the battery is full, Skybox curtails PV production so it is always less than the load.

Self Consumption

- Displace as much of the customer load as possible, by serving it with PV generated power.

Net Metering with Battery Backup

- Maintains battery SoC
- Sells excess PV generation back to the utility grid when available. A net metering agreement with the utility is required.

Maximum Independence

- Opens the grid relay and prioritizes using power from the battery and the PV array

Skybox Optimization

For Non-Export and Net-Metering Profiles

Time of Use Optimization

Serves loads from PV first, then from either grid or battery

Chooses best source depending on the Lowest Levelized Cost of Energy

TOU is not used in Self consumption and Maximum Independence

Setup Wizard

11. DEMAND CHARGES

12. EXTERNAL CT

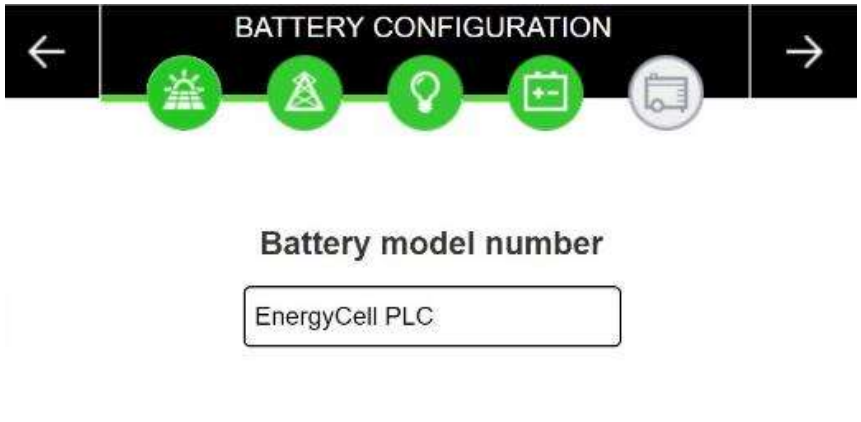
Setup Wizard

13. INTERCONNECTION PROFILE

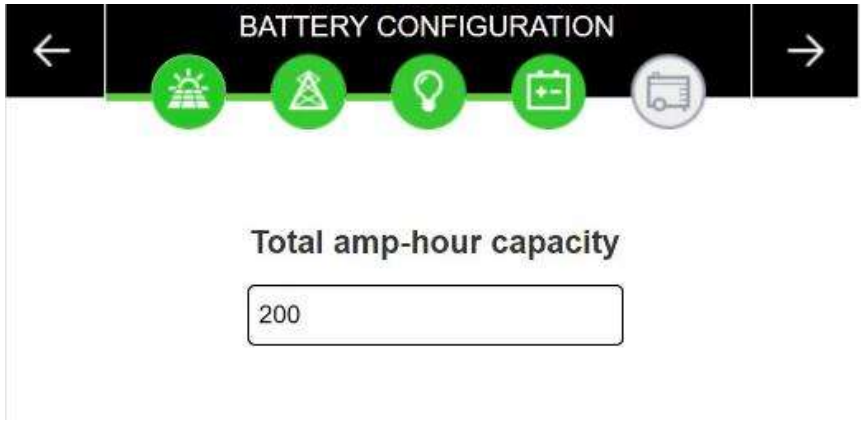
14. BATTERY SERIES

Setup Wizard

15. BATTERY MODEL

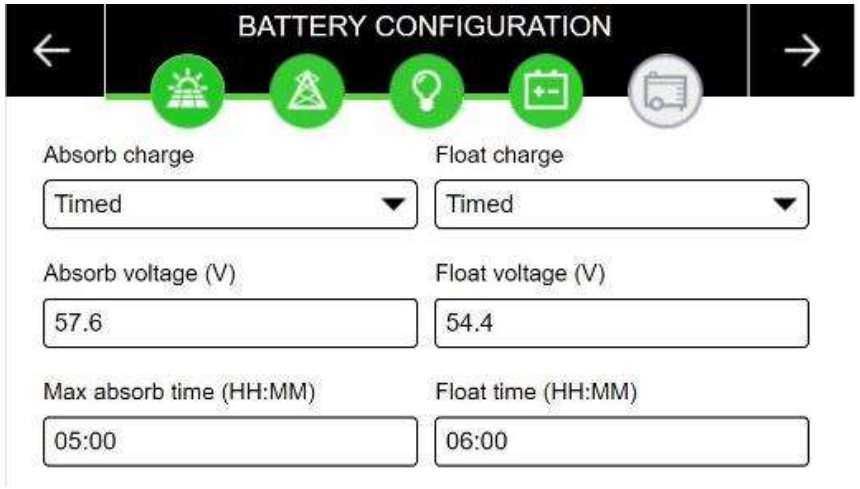


16. AMP-HOUR CAPACITY

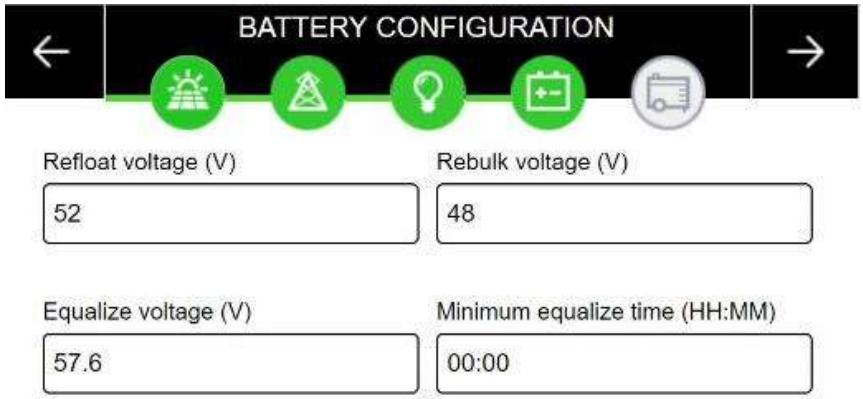


Setup Wizard

15. BATTERY CONFIGURATION



16. BATTERY CONFIGURATION



Designing for multiple profiles

PROGRAMMING SET-POINTS & DESIGN

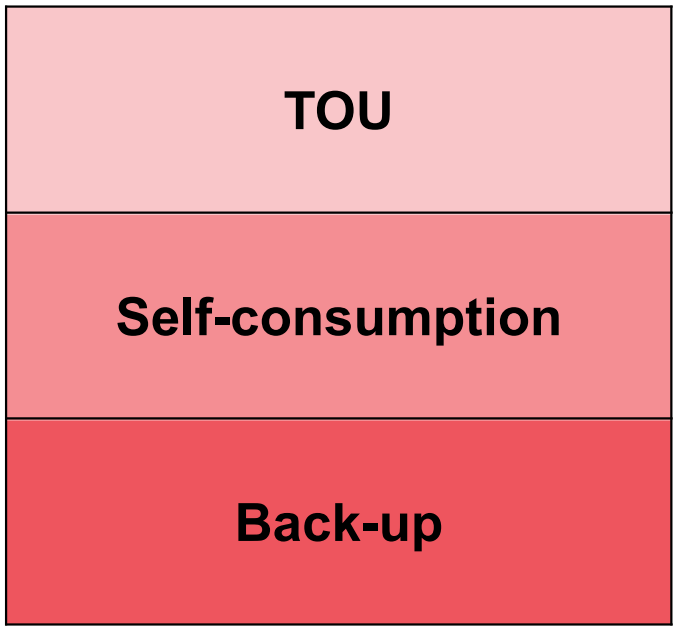
Skybox can be programmed to function for multiple profiles

- **Battery Sizing**

  Daily cycling for self-consumption & TOU

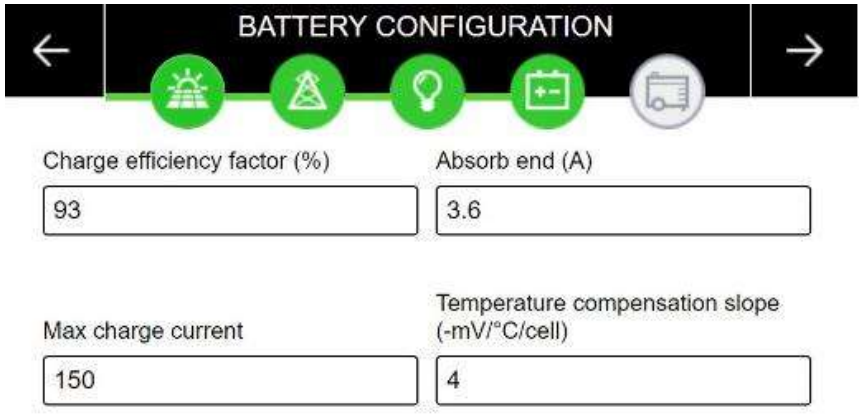
  Reserves for back-up

- **Maximum flexibility**



Setup Wizard

15. BATTERY CONFIGURATION



16. OWNER PASSWORD

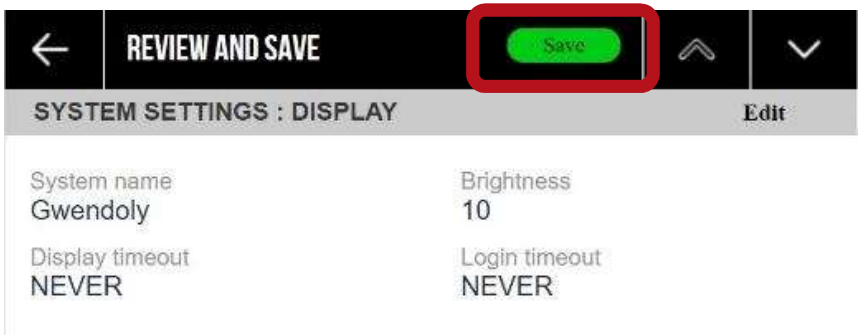
Setup Wizard

15. INSTALLER PASSWORD

16. INSTALLER INFO

Setup Wizard

15. REVIEW & SAVE



Thank you for your time.

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Questions?